PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of
Maocheng LI *et al.*
Appln. No.: **09/774,192**
Filed: Jan. 29, 2001
Conf. No.: 7295
Title: ICP WINDOW HEATER INTEGRATED WITH FARADAY SHIELD FOR FLOATING ELECTRODE BETWEEN SOURCE POWER COIL AND ICP WINDOW

Atty. Dkt. No.: 5430
Group Art Unit: 1763
Examiner: A. Crowell

APPELLANT'S BRIEF ON APPEAL UNDER 37 C.F.R. § 1.192

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In accordance with the provisions of 37 C.F.R. § 1.192, Appellant submits the following:

I. REAL PARTY IN INTEREST

Based on information supplied by Appellant, and to the best of Appellant's legal representatives' knowledge, the real party in interest is the assignee, Applied Materials, Inc.

II. RELATED APPEALS AND INTERFERENCES

Appellant, as well as Appellant's assigns and legal representatives are unaware of any appeals or interferences which will be directly affected by, or which will directly affect, or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-18, 20-28, and 33-42 are currently pending. No claims have been allowed. Claims 19 and 29-32 have been canceled. Claims 3, 16-18, and 22-27 have been withdrawn from consideration as being directed to non-electing inventions. Claims 28, 33-39, and 42 are appealed. A listing of all pending claims 1-18, 20-28, and 33-42 is set forth in the attached Appendix, including appealed claims 28, 33-39, and 42 as finally rejected.

IV. STATUS OF AMENDMENTS

The clarifying amendment of claim 14 filed subsequent to the final rejection has been entered, contingent upon filing of an appeal brief, per the Advisory Action dated July 21, 2003.

V. SUMMARY OF THE INVENTION

Appellants' disclosed and claimed invention is directed to an apparatus for processing a semiconductor wafer.

The claimed apparatus (refer to Fig. 1) is a vacuum chamber **110** combined with a heater **130**, an RF coil **120**, and a Faraday shield **130**. *See* the specification at ¶¶ 48, 49 on page 8. Although not limited to such by the claim language, this invention arises in the context of plasma processing of semiconductor wafers. Selected gasses are permitted to flow into

the chamber and are energized into a plasma state so that they react with the surfaces of the semiconductor lying in the chamber. *Ibid.* at ¶ 19 on pages 3, 4.

The plasma is sustained inside the vacuum chamber primarily by the energy that is inductively coupled into the chamber from the RF coil when the coil is energized. The Faraday shield suppresses (although not entirely) capacitive coupling between the RF coil and the semiconductor wafer, in order to minimize undesired etching of the chamber wall. *Ibid.* at ¶ 89 on page 17.

The relationship between the chamber wall **720** of the vacuum chamber, the Faraday shield **710,** and the heater **730, 731** is well illustrated in the detail section view of Fig. 7. The Faraday shield **710** is disposed between the heater **730, 731** and the chamber wall **720.** *Ibid.* at ¶ 67 on page 12.

The heater **730, 731** produces heat energy that is coupled to the chamber wall **720** via the thermally conductive shield **710.** *Ibid.*

Keeping the chamber lid at a consistent elevated temperature (made possible by the present invention) is helpful to semiconductor manufacture because it keeps the inside of the chamber clean. The elevated temperature discourages condensation of reactants and by-products on the chamber surface. Keeping the

temperature consistent avoids thermal cycling. It is good to avoid thermal cycling because thermal cycling can lead to flaking off of any condensation that does accrete on the inside surface of the chamber wall. Such flaking inside the chamber causes all manner of mischief to the semiconductor wafers being processed through the chamber.

The cleaner the chamber can be kept the better. Although there is no way to keep the inside of the chamber from getting dirty, the claimed invention is effective to slow the rate of accretion and decreases the likelihood of flaking. This increases the amount of time between necessary cleanings. Increasing the time interval between cleanings is important because while the chamber is being cleaned it is not processing wafers and is not contributing to production. Down time for cleaning negatively affects manufacturing efficiency and has a real, not insignificant economic impact.

VI. ISSUE

The sole issue on appeal is this:

Are claims 28, 33-39, and 42 obvious over Guo (US 5944899) in view of Yoshida (US 5735993), within the meaning of 35 U.S.C. § 103(a)?

VII. GROUPING OF CLAIMS

All of appealed claims 28, 33-39, and 42 stand or fall together.

VIII. ARGUMENTS

In order to make out a *prima facie* case of obviousness, the prior art must teach or suggest each and every limitation of the claimed invention, as the invention must be considered as a whole. *In re Hirao*, 535 F.2d 67, 190 U.S.P.Q. 15 (C.C.P.A. 1976).

Independent claim 28 defines over the teachings in Guo and Yoshida. The Guo reference teaches neither a shield structure, nor a heater structure; the Examiner concedes this. The Yoshida reference teaches both the heater and shield to be embedded inside the chamber lid. Claim 28 recites the limitation of both the heater and the shield being located outside the chamber. In particular, claim 28 recites the limitation of:

> a heater disposed outside of the vacuum chamber in thermal contact with the chamber wall

at lines 5-6. Claim 28 also recites the limitation of:

> a Faraday shield having variable shielding efficiency, the shield being disposed between the heater and the chamber wall.

See lines 10-11. Nothing in the prior art teaches or suggests this combination of limitations.

The claimed arrangement, with the heater disposed outside of the chamber with the Faraday shield being located between the heater and the chamber wall is not arbitrary. This arrangement provides identifiable advantages that the prior art arrangements do not. By keeping the heater and the shield out of the chamber (as opposed to the configuration of Yin (WO 00/52973), of record but not applied in this rejection) the semiconductor processing apparatus according to the claimed invention has fewer parts inside the chamber to get dirty and then be in need of cleaning. By keeping the heater and the shield from being embedded inside the chamber lid (as opposed to the Yoshida configuration) the semiconductor processing apparatus according to the claimed invention has the flexibility of implementation and maintenance that permits parts (i.e., the heater or shield) to be swapped out without breaking vacuum (i.e., opening up the chamber).

Avoiding the need to break vacuum is important in the semiconductor production environment because it is time consuming and the machine is non-productive during that time. The need to clean dirty parts inside the chamber or to replace broken parts inside the chamber or embedded in the chamber wall are both causes for breaking vacuum and causing down time for a production machine on a manufacturing floor. Minimizing this is meaningful in the manufacturing context. Because the claimed structure

helps to minimize this, it is a meaningful difference, not an arbitrary choice.

Moreover, the prior art references do not suggest such a configuration because, to the extent they teach anything about heaters and shields, they teach away from the claimed configuration. Yoshida rejects the placement of a Faraday shield outside the chamber (refer to Yoshida's Fig. 8, which purports to illustrate the prior art) and advocates that the shield be placed inside the chamber ceiling along with the heater. Such teaching away in the prior art cannot be ignored and must be taken into account in an obviousness analysis. That is because the prior art must be considered as a whole. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 U.S.P.Q. 303 (Fed. Cir. 1983), *cert. denied* 469 U.S. 851 (1984).

The Yin reference (of record, but not applied in this rejection) actually suggests the opposite of a heater outside the chamber because, rather than heating the chamber exterior, the structure taught by Yin cools the chamber exterior. Certainly, this is a teaching away from placing a heater on the outside of the chamber, since heating is the opposite of cooling. Yin does disclose a heater, but advocates that the heater be placed inside the chamber rather than outside. Since the prior art must be

considered as a whole, this teaching away from the claim cannot be ignored. *Ibid.*

IX. CONCLUSION

For the above reasons, Appellant respectfully submits that the Examiner has failed to make out a *prima facie* case of obviousness with regard to claims 6-15, 20, 21, and 41, and asks that the obviousness rejection be reversed.

The present Brief on Appeal is being filed in triplicate.

Appellant hereby petitions for any extension of time that may be required to maintain the pendency of this case, and any required fee for such extension is to be charged to Deposit Account No. 18-1579.

Respectfully submitted,
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APPENDIX

Listing of the claims:

1. *(Once Amended)* In combination, a heating element, a Faraday shield, and a semiconductor processing chamber, the semiconductor processing chamber comprising:

a wafer support disposed inside the chamber,

a gas delivery channel disposed in the chamber to deliver gas adjacent the wafer support, and

a chamber wall, the chamber wall being in thermal contact with the heating element;

wherein the Faraday shield is disposed between the heating element and the chamber wall.

2. *(Original)* The combination of claim 1, wherein the heating element is an electrical heating element.

3. *(Withdrawn)* The combination of claim 1, wherein the heating element comprises:

a conduit, and

a thermal working fluid flowing through the conduit.

4. *(Once Amended)* The combination of claim 1, wherein the Faraday shield has a circular shape.

5. *(Once Amended)* The combination of claim 4, wherein the Faraday shield comprises:

a circular loop; and

radial segments connected together by the circular loop.

6. *(Once Amended)* A temperature management apparatus for promoting thermal uniformity for a chamber wall, the apparatus comprising:

a Faraday shield having a predetermined shape and having edges;

a resistive heating element layered over the Faraday shield adjacent to the edges of the Faraday shield;

wherein the Faraday shield is electrically isolated from the resistive heating element and provides thermal communication from the resistive heating element to the chamber wall.

7. *(Original)* The temperature management apparatus of claim 6, wherein the predetermined shape promotes even distribution of heat energy over the chamber wall.

8. *(Original)* The temperature management apparatus of claim 6, further comprising:

a source of air flow disposed near the chamber wall so as to remove excess heat energy.

9. *(Original)* The temperature management apparatus of claim 8, where the source of air flow comprises a fan.

10. *(Original)* The temperature management apparatus of claim 6, further comprising:

a temperature sensor adapted to be disposed in intimate contact with the chamber wall so as to generate a temperature signal indicative of the temperature of the chamber wall; and

a power control circuit connected to receive the temperature signal as a feedback signal so as to provide a controlled amount of power dissipated by the resistive heating element.

11. *(Original)* The temperature management apparatus of claim 10, wherein the power dissipated by the resistive heating element is controlled so as to be at a minimum level when plasma is energized near the chamber wall, and to be at a maximum level when no plasma is energized near the chamber wall.

12. *(Original)* The temperature management apparatus of claim 11, wherein the minimum level corresponds to substantially no power dissipation.

13. *(Original)* The temperature management apparatus of claim 6, wherein the predetermined shape is substantially

radially symmetric.

14. *(Two Times Amended)* The temperature management apparatus of claim 13, wherein the predetermined shape comprises plural radial elements and a circular element, disposed at the outer edge of the Faraday Shield, joining the plural radial elements together.

15. *(Original)* The temperature management apparatus of claim 14, wherein at least one gap is formed in the circular element.

16. *(Withdrawn)* The temperature management apparatus of claim 15, wherein at least two gaps are formed in the circular element, the gaps being arranged substantially symmetrically.

17. *(Withdrawn)* The temperature management apparatus of claim 13, wherein the predetermined shape comprises plural radial elements and a circular element, disposed near the center of the Faraday shield, joining the plural radial elements together.

18. *(Withdrawn)* The temperature management apparatus of claim 17, wherein at least one gap is formed in the circular element.

19. *(Canceled)*

20. *(Original)* The temperature management apparatus of claim 6, wherein the resistive heating element comprises: plural resistive segments arranged such that spatially adjacent ones of the plural resistive segments have electrical current flowing in opposite directions.

21. *(Original)* The temperature management apparatus of claim 20, wherein the plural resistive segments are electrically connected in series with one another.

22. *(Withdrawn)* A temperature management apparatus for promoting thermal uniformity for a chamber wall, the apparatus comprising:

a fluid conduit having a predetermined shape and having a substantially flattened cross section; and

a thermal working fluid disposed in and flowing through the fluid conduit.

23. *(Withdrawn)* The temperature management apparatus of claim 22, wherein the predetermined shape promotes even distribution of heat energy over the chamber wall.

24. *(Withdrawn)* The temperature management apparatus of

claim 22, wherein the predetermined shape is substantially radially symmetric.

25. *(Withdrawn)* The temperature management apparatus of claim 22, further comprising:

a source of air flow disposed near the chamber wall so as to remove excess heat energy.

26. *(Withdrawn)* The temperature management apparatus of claim 25, where the source of air flow comprises a fan.

27. *(Withdrawn)* The temperature management apparatus of claim 22, where the thermal working fluid is provided via connection to a temperature controlled reservoir.

28. *(Once Amended)* An apparatus for processing a semiconductor wafer comprising:

a vacuum chamber adapted to receive the semiconductor wafer therein, the vacuum chamber having a chamber wall;

a heater disposed outside of the vacuum chamber in thermal contact with the chamber wall;

an RF coil disposed adjacent to the vacuum chamber so as to couple RF energy into the vacuum chamber, the heater being disposed between the RF coil and the chamber wall; and

a Faraday shield having variable shielding efficiency, the shield being disposed between the heater and the chamber wall.

29-32. *(Canceled)*

33. *(Once Amended)* The apparatus for processing a semiconductor wafer of claim 28, wherein the heater is substantially electrically transparent to the RF energy coupled into the chamber.

34. *(Original)* The apparatus for processing a semiconductor wafer of claim 28, wherein the chamber wall is a flat lid.

35. *(Original)* The apparatus for processing a semiconductor wafer of claim 28, wherein the chamber wall is a dome-shaped lid.

36. *(Original)* The apparatus for processing a semiconductor wafer of claim 28, wherein the chamber wall is a hemispherical shaped lid.

37. *(Once Amended)* The apparatus for processing a semiconductor wafer of claim 39, wherein the source of air flow comprises a fan.

38. *(Original)* The apparatus for processing a semiconductor wafer of claim 28, wherein the heater is in physical contact with

the chamber wall.

39. *(Previously Presented)* The apparatus for processing a semiconductor wafer of claim 28, further comprising:

a source of air flow disposed near the dielectric wall to remove excess heat energy.

40. *(Previously Presented)* The combination of claim 1, wherein the chamber wall comprises the chamber ceiling.

41. *(Previously Presented)* The temperature management apparatus of claim 6, wherein the chamber wall comprises the chamber ceiling.

42. *(Previously Presented)* The apparatus for processing a semiconductor wafer of claim 28, wherein the chamber wall comprises the chamber ceiling.